



Achievement of Emission Reduction and Euro V by Innovative Auxiliary Systems

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- Plant 1, Skofja Loka
- Plant 2, Ljubljana
- TCG Metal Cast Benkovac, Croatia
- TCG Larnica Ohrid, Macedonia



TCG Unitech Systemtechnik GmbH

is part of the worldwide operating TCG Group with competence in die casting and plastic injection molding.

has its main goal in the development and production of pump and camshaft timing systems.

offers the experience in the layout and development of pumps built up since years and many different challenging projects.

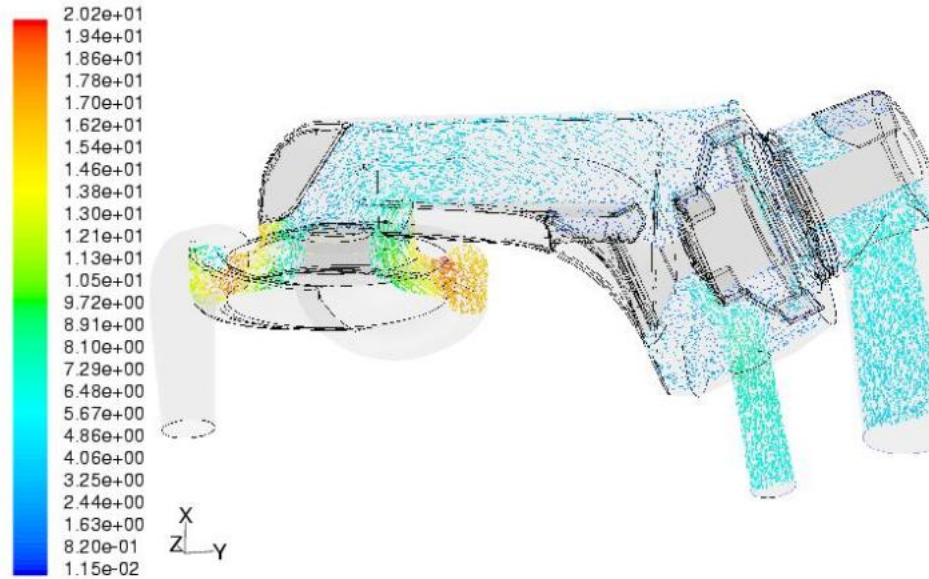
has the flexibility to cope with requirements appearing with the implementation of new systems at short notice.

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Main Trends in Engine Development on the Way to Reduced Emissions and Euro V

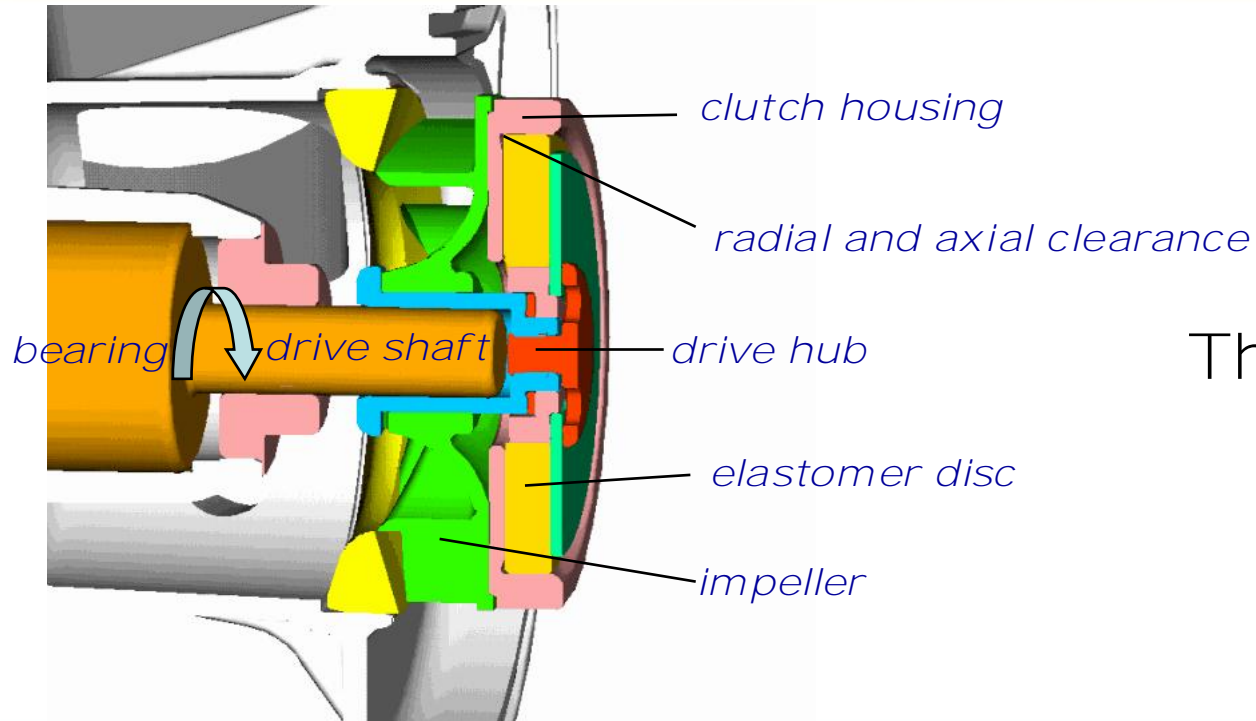
- Hybrid systems
- Downsizing
- Shortening of the warm up time
- Integration of oil circuits into the thermomanagment
- EGR and Integration of exhaust gas into the thermomanagement
- Optimisation of fluid flows
- Cooling and heating as necessary
- Cam shaft adjustment
- Different cooling circuits
- More accurate control of the operating temperature of the ICE

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Innovative and Optimised Systems for the Cooling Circuit

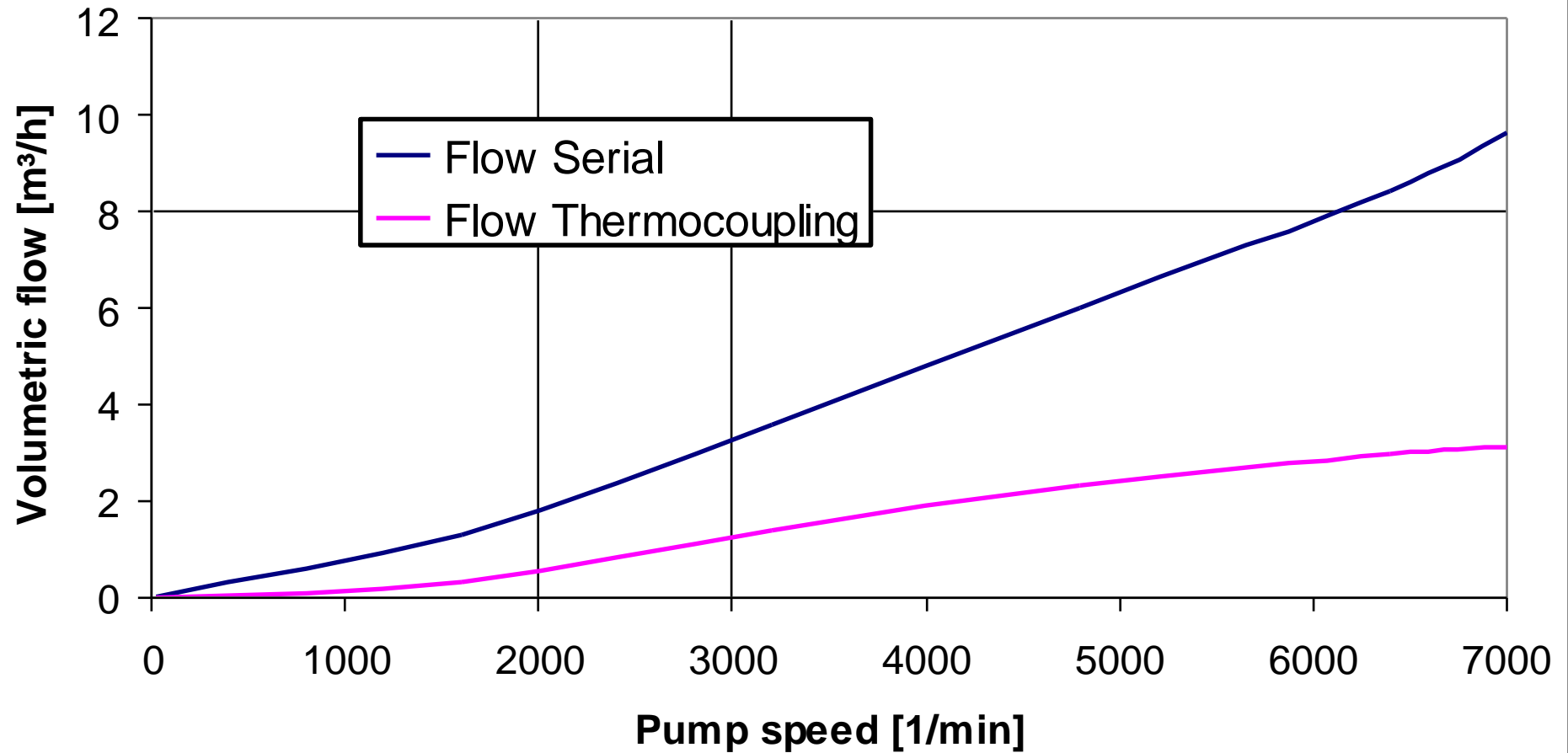
- Optimised mechanically driven pumps
- Thermocoupling
- Electrically driven auxiliary pumps
- Electrically driven main pumps



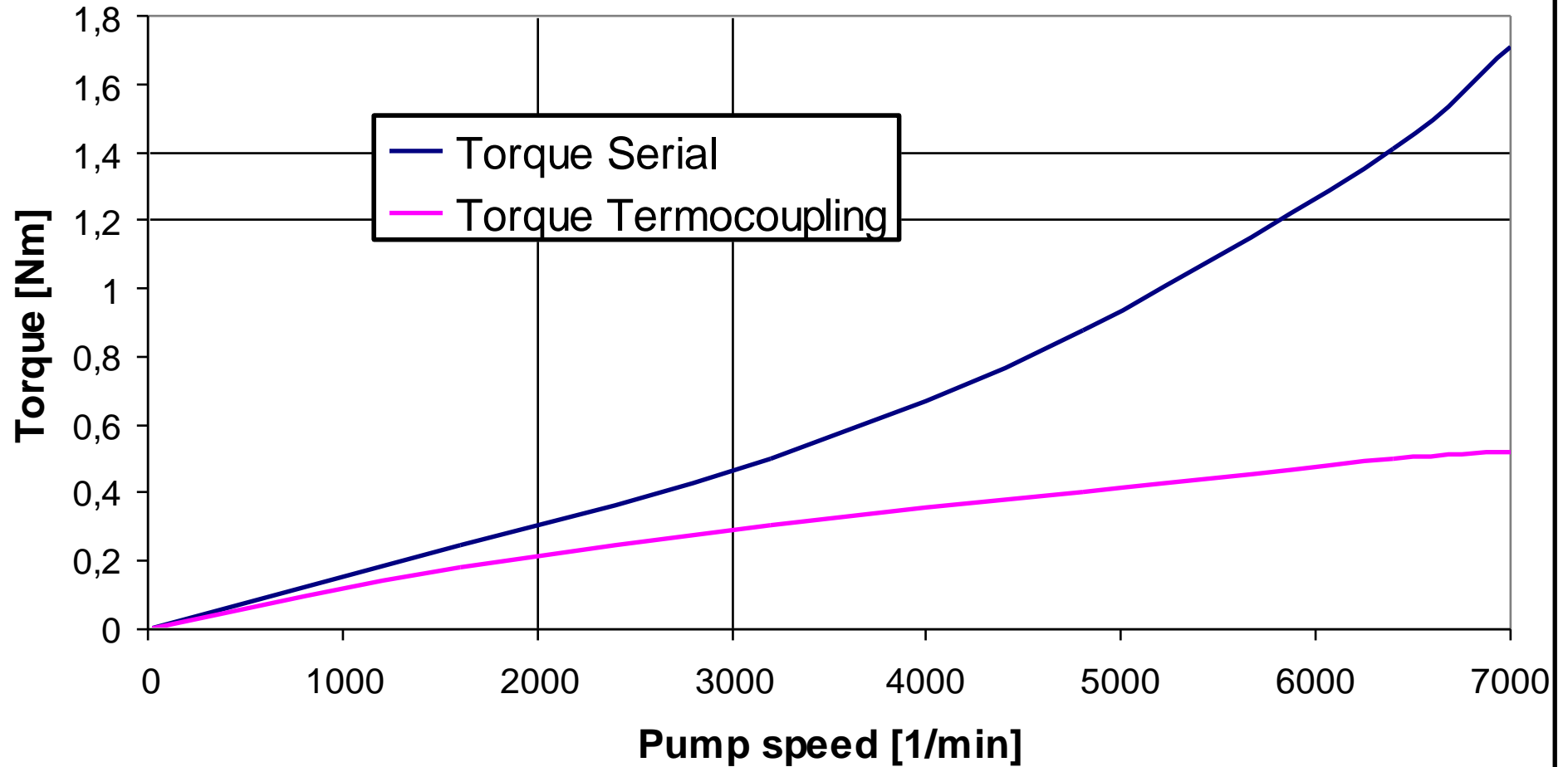
Thermocoupling

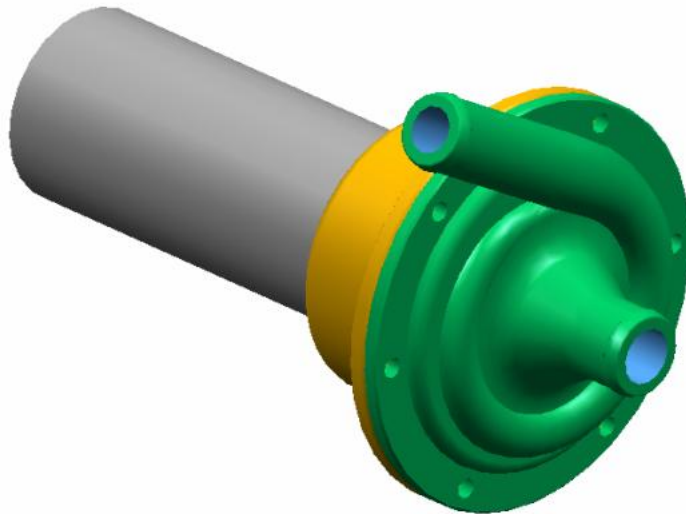
- **Function:**
Drastically reduced impeller speed at cold start based only on hydrodynamic forces. More expansion of the elastomer disc than the clutch housing during warmup resulting in an engagement at an adjustable coolant temperature.
- **Advantages:**
Reduced coolant flow leads to faster warm up of the engine.
Shortened warm up means lower emissions and fuel consumption.
Easy to adapt on existing pumps at low extra costs.

Comparison of Pump Flow for Serial Pump and Thermocoupling



Comparison of Torque for Serial Pump and Thermocoupling

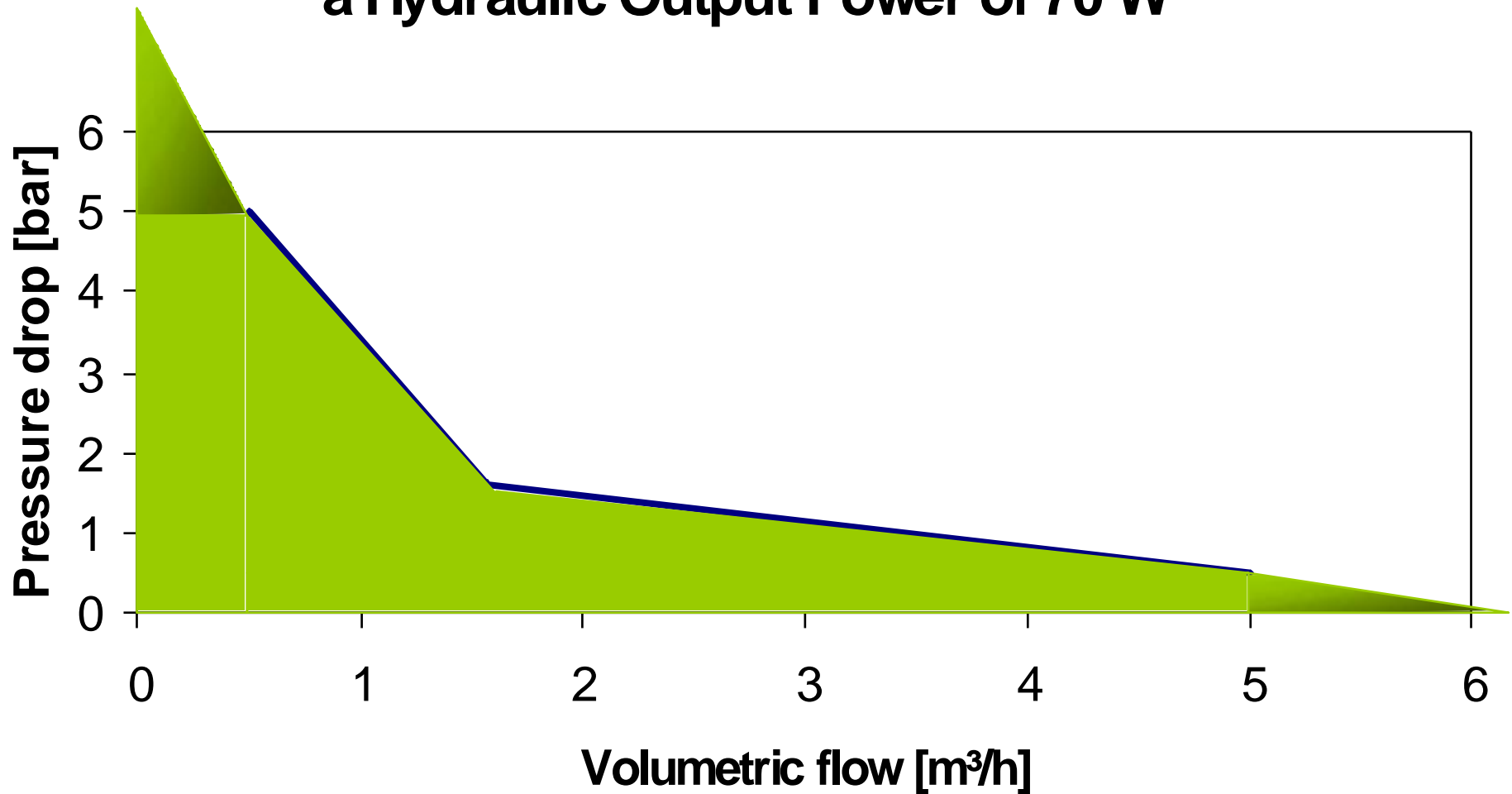


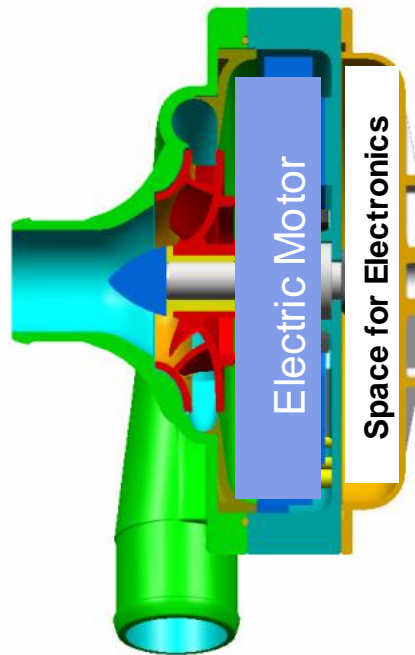


Electrically Driven Auxiliary Coolant Pumps

- **Main requirements:**
 - Minimisation of overall dimensions and noise level
 - Maximisation of efficiency and lifetime (DC/EC)
 - High temperature resistance (min. 150 °C)
- **Tailor made solutions:**
 - according to space and electrical power guidelines
 - regarding the hydraulic power output (e.g. high pressure layout)
 - with patented innovative sealing concepts
 - for new cooling principles and other specific requirements

Feasible Combinations of Flow and Pressure for a Hydraulic Output Power of 70 W

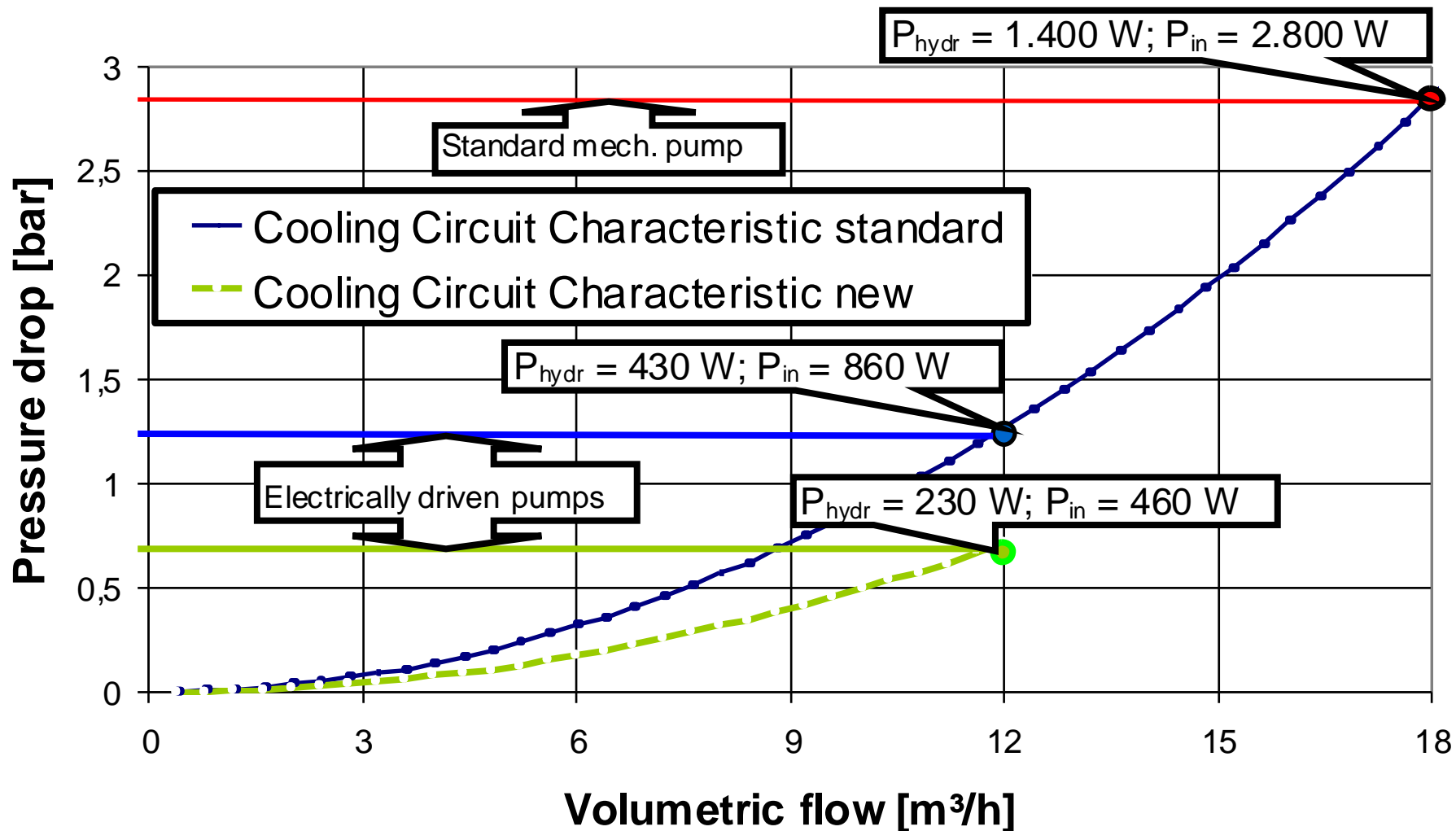




Electrically Driven Main Coolant Pumps

- **Concept:**
Electrically commutated disc motor in an „all wet“ configuration.
Low speed layout to reduce losses, wear of bearings and noise.
- **Advantages:**
Compact design with best cooling conditions for motor and electronics.
Best power to weight ratio.
- **Layout:**
9 m³/h at 0.9 bar, 600 W el. input power at 12V
(up to 1000 W at 12 V resulting i.e. in 12 m³/h at up to 1.5 bar are feasible)

Pump Layout for Different Configurations





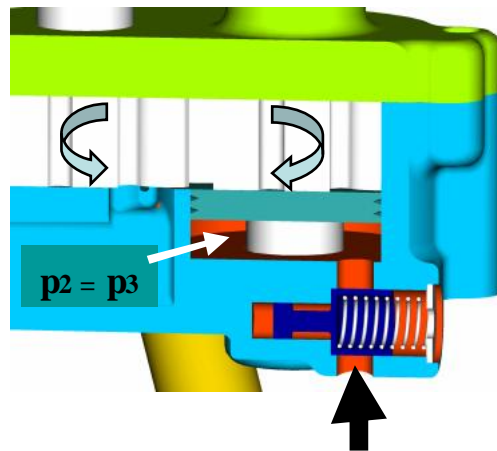
Tests

- Endurance trials on test benches:
- MVEG cycles and heavy duty drive tests on a roller type test bench:
- Results:
 - Verification of a reduced power consumption
 - Reduction of fuel consumption between 1 and 2 percent
 - Shortening of the warmup time at cold start by 50 %
 - Reduction of emissions
 - More accurate control of coolant temperature

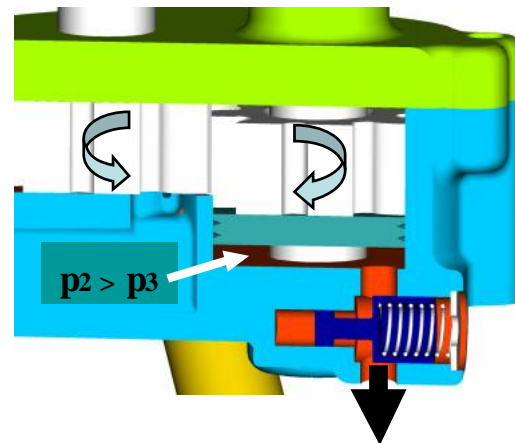


Innovative and Optimised Systems for the Oil Circuit

- Optimised mechanically driven pumps
- Gap controlled oil pump
- Electrically driven auxiliary/booster pumps



Evade chamber closed



Evade chamber open

Gap Controlled Oil Pump

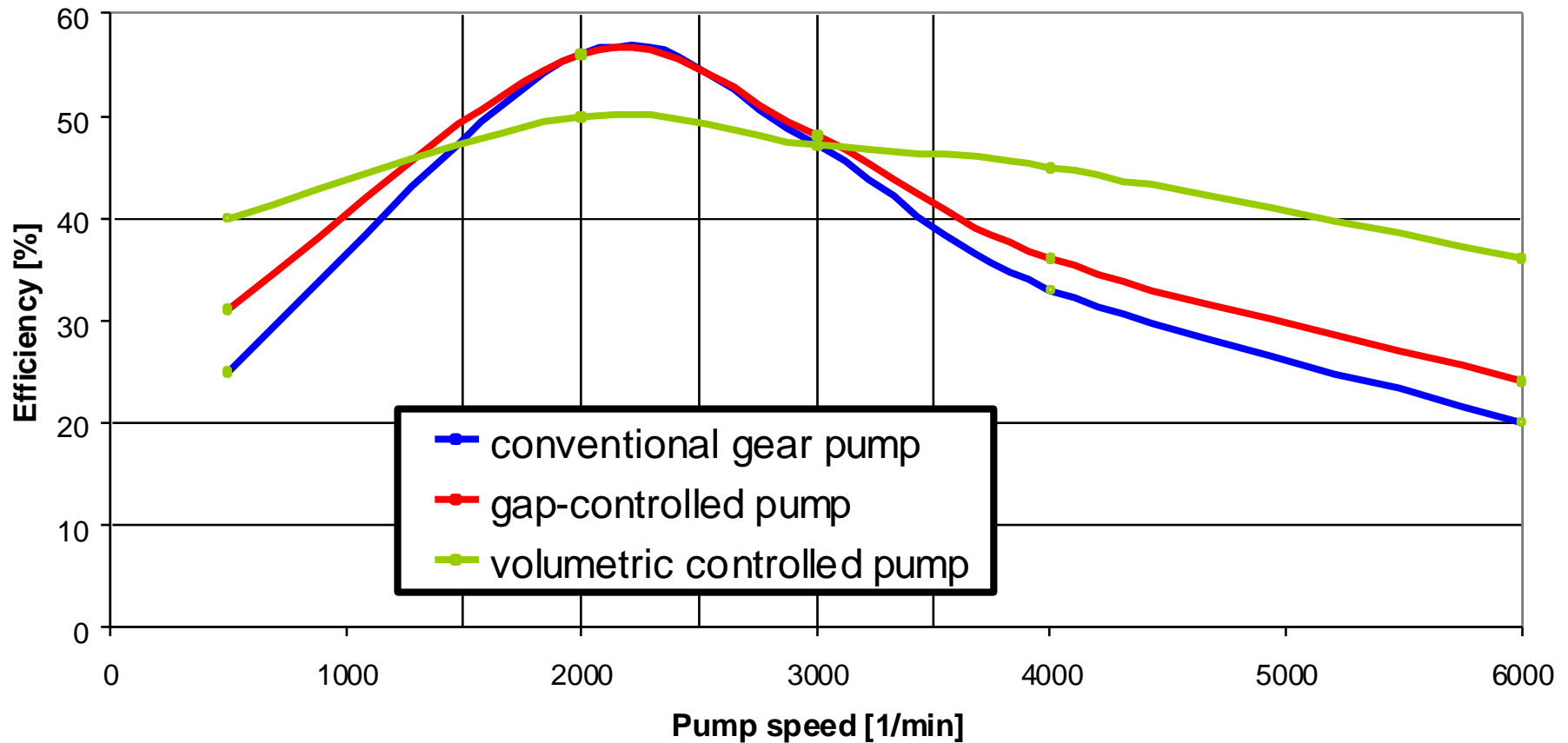
- **Concept/Function:**

By moving the driven gear in axial direction a direct bypass between suction and pressure side is opened which results in reduced flow and pressure.

- **Advantages:**

Less complexity by eliminating the control valve capable for high flows.
Lower power input and the possibility of different control mechanisms.
Reduced space and costs.

Comparison of Different Oil Pump Concepts



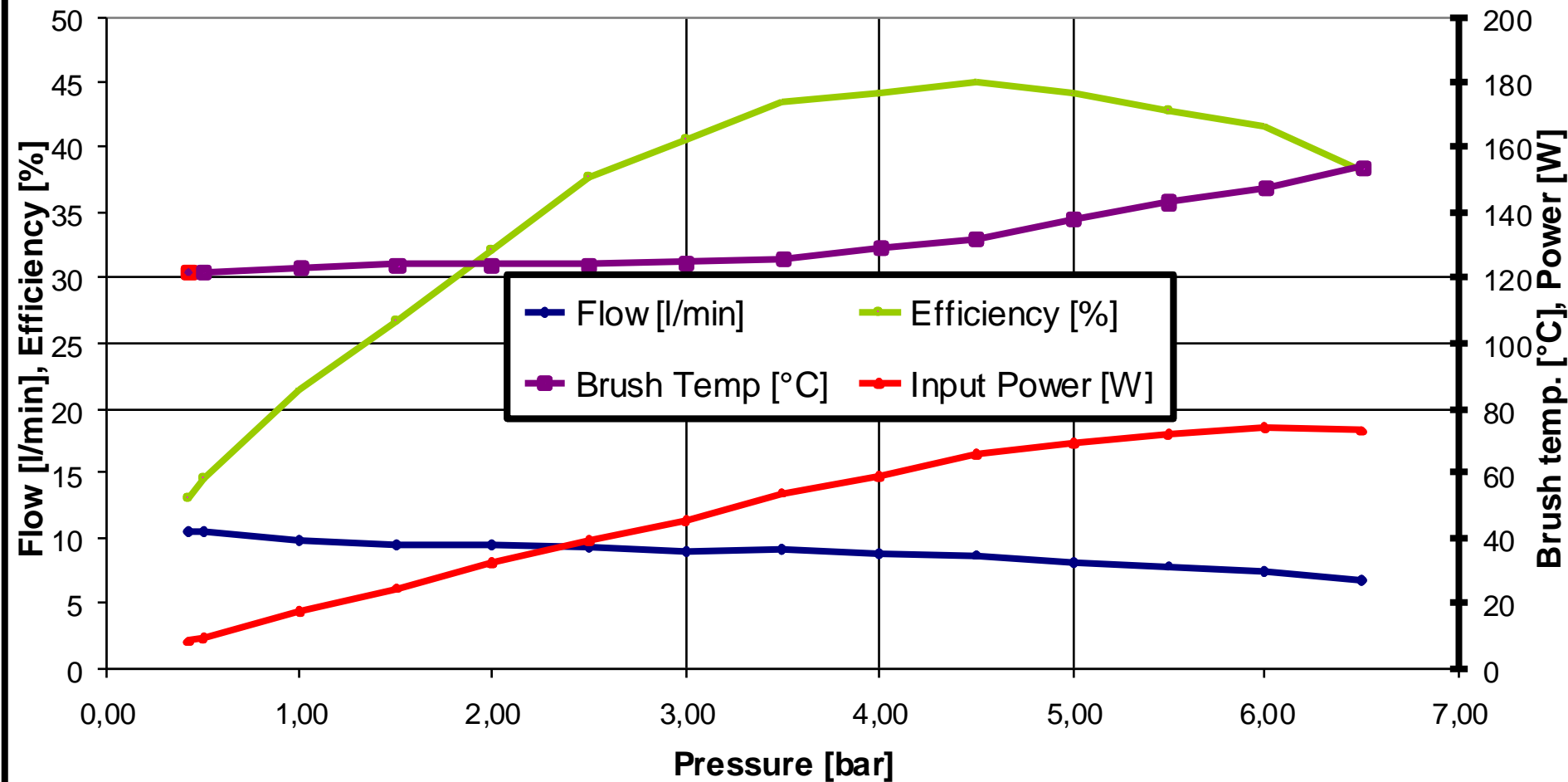


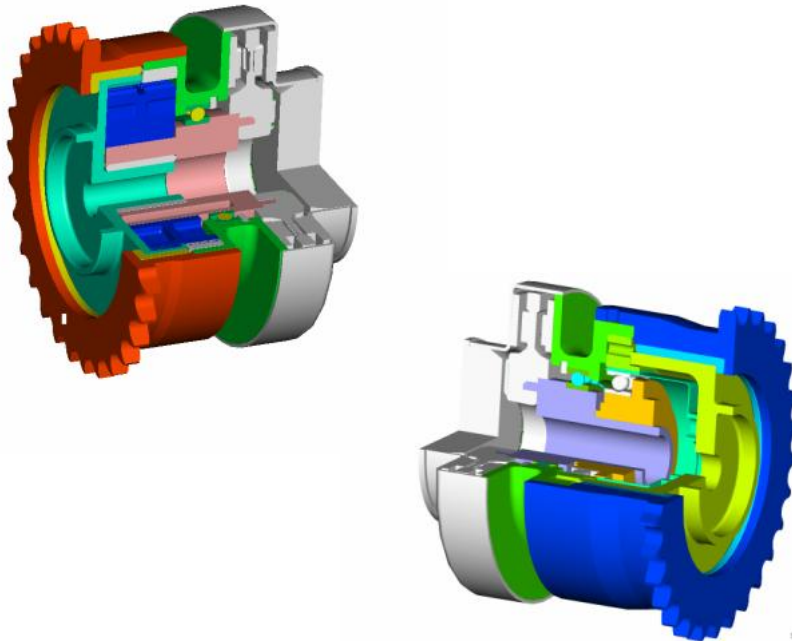
Electrically Driven Auxiliary/Booster Oil Pumps

- **Main requirements:**
 - Minimisation of overall dimensions and noise level
 - Maximisation of efficiency
 - High temperature resistance (min. 150 °C)
- **Tailor made solutions:**
 - according to space and electrical power guidelines
 - regarding the hydraulic power output (e.g. high pressure layout)
 - to fulfil specific other requirements

Oilpump Test Data at 12V, 90°C

Layout 8 l/min, 4,5 bar





Electrically Driven Camshaft Timing Systems

- **Concept and main layout:**

Use of a small electric motor with a high diameter to length ratio to fit into available space in combination with a gear with high ratio.

Adjustment angle acc. to requirements, adjustment speed min. 50 degrees/sec.

- **Advantages:**

- Power input on demand and full availability at cold start.
- Small and dynamic electric motor.



Summary and Conclusion

- Optimisation, innovative concepts and electrification of auxiliary systems open up high potentials for emission and fuel consumption reduction.
- To gain the full potential the whole system has to be considered.
- TCG Unitech Systemtechnik has the know-how and ability to be a competent partner on layout, development, prototypes, testing and high volume production of pump and camshaft timing systems.



Thank you for your attention

For further questions please
contact us at booth No. 6064

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